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Abstract

Background

Previous Canadian estimates of hospital use by smoking history have been derived by applying disease-specific "smoking-attributable fractions" to administrative data. For this analysis, health survey data were linked to hospitalization data at an individual level, permitting prospective measures of hospital use by smoking status and age.

Data and methods

Data for 28,255 respondents (outside Quebec) to the 2000/2001 Canadian Community Health Survey (CCHS) were linked to the Hospital Person-Oriented Information Database. Days in hospital over four years were quantified for each respondent and examined in relation to smoking status in 2000/2001. Multiple logistic regression was used to examine the association between smoking and hospitalization, while controlling for confounders.

Results

During the four years after their CCHS interview, current daily smokers and former daily smokers who had quit in the past five years averaged more than twice as many days in hospital as did never-daily smokers. Altogether, excess hospital days for current and former smokers aged 45 to 74 numbered 7.1 million over four years, and accounted for 32% of all hospital days used by people in this age group.

Keywords

health surveys, medical record linkage, risk factors

Authors

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Hospital care for smoking-related illnesses constitutes an important part of the health care burden. However, because hospital administrative records contain only limited information, quantifying hospital use according to patients' personal characteristics is challenging. For example, although smoking may have contributed to the illness for which a person is hospitalized, no information on smoking history is captured in the administrative discharge abstract.

An indirect method of assessing the impact of smoking on hospital use has been to apply the "attributable fraction" for diseases that have been shown to be etiologically associated with smoking. The attributable fraction is the proportion by which the incidence of a disease would be reduced in the population if smoking were eliminated. Smoking-attributable days in hospital are calculated by multiplying each disease- and age-specific fraction (based on the literature) by the total number of hospital days for that disease. Since the early 1980s, studies in Canada and elsewhere have employed this approach to estimate health care use associated with smoking.[1-6]

Estimates derived from the attributable-fraction approach are limited in several ways. First, calculations are based on disease-specific risk estimates in the literature, so their precision depends on the quality of the underlying evidence. Second, the attributable-fraction approach does not include conditions for which there is currently insufficient understanding of their true association with smoking. Third, this approach does not cover smokers' higher risks of complications after surgery and slower recovery time.[7-15]

A more accurate technique for quantifying smoking-related hospital use involves the collection of baseline data from a cohort, and monitoring their hospital use over a period of time. Few studies have employed this method, probably because of the considerable resources required for follow-up.[16,17] A similar, but less expensive, method entails linking survey data from a specified baseline year with administrative data covering a subsequent follow-up period.[18-20] Recent linkage of health

survey data to hospital administrative data offers an opportunity to study the association between smoking status and use of acute care hospitals in Canada.

The objective of this study was to quantify the likelihood of hospitalization, and estimate time spent in hospital, according to smoking status. The study is based on a sample of respondents aged 45 to 74 to the 2000/2001 Canadian Community Health Survey, whose hospitalization experience was monitored prospectively for four years through linkage of the survey data with the Hospital Person-Oriented Information database.

Methods

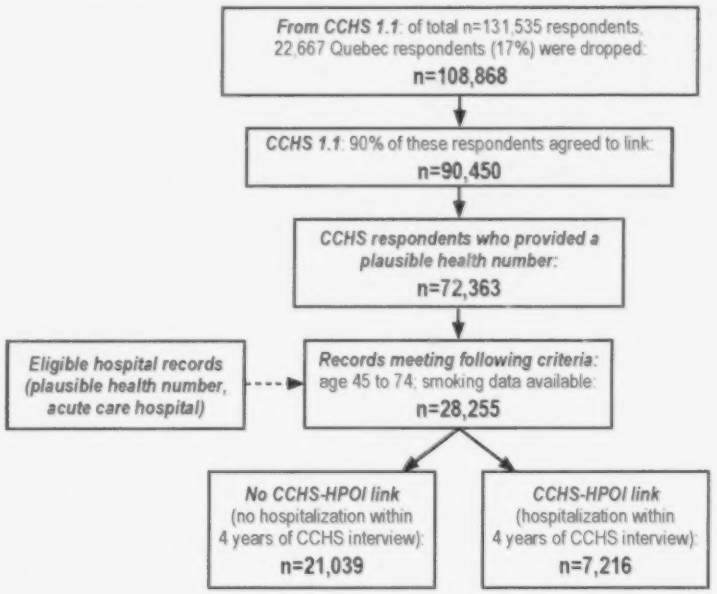
Data source

Canadian Community Health Survey

Data on smoking and other personal characteristics are from the 2000/2001 Canadian Community Health Survey (CCHS). The survey collects cross-sectional information about the health of Canadians on an ongoing basis. It covers the non-institutionalized household population aged 12 or older in all provinces and territories, except members of the regular Canadian Forces and residents of Indian reserves, of Canadian Forces bases (military and civilian) and of some remote areas. A description of the methodology has been previously reported.[21]

The overall response rate to the 2000/2001 CCHS was 85%; the total sample numbered 131,535. Insufficient information was available in the hospital data for Quebec residents' records to be linked (see *Hospitalization data*); therefore, the 22,667 (17%) CCHS respondents in Quebec were dropped. Of the 108,868 respondents who remained, 90,450 had given permission for their survey data to be linked to administrative data. Check-digit algorithms were used to verify the plausibility of the health numbers they provided; 72,363 provided a plausible health number. Respondents aged 45 to 74 numbered 28,288, but data on smoking status were not available for 33 of them (Figure 1). Approximately half of them had been surveyed by telephone, and the other half, in person (data not shown).

Figure 1
Creation of analysis file


From CCHS 1.1: of total n=131,535 respondents, 22,667 Quebec respondents (17%) were dropped:
n=108,868
CCHS 1.1: 90% of these respondents agreed to link:
n=90,450
CCHS respondents who provided a plausible health number:
n=72,363
Eligible hospital records (plausible health number, acute care hospital)
Records meeting following criteria: age 45 to 74; smoking data available:
n=28,255
No CCHS-HPOI link (no hospitalization within 4 years of CCHS interview):
n=21,039
CCHS-HPOI link (hospitalization within 4 years of CCHS interview):
n=7,216

Source: 2000/2001 Canadian Community Health Survey (CCHS) and 2000-2005 Hospital Person-Oriented Information (HPOI)

Survey weights were produced by Statistics Canada to adjust for non-response to the CCHS, as well as for the exclusion of records of respondents who did not provide plausible health numbers or give permission for linkage to administrative health data. These weights were applied to the analysis file; the weighted data were representative of the Canadian household population residing outside Quebec.

Hospitalization data

Statistics Canada's Hospital Person-Oriented Information database (HPOI) is a person-level dataset derived from discharge records of inpatients in most of the acute care hospitals and some psychiatric, chronic and rehabilitation hospitals across Canada.[22] The discharge records contain demographic (for example, date of birth, postal code), administrative (health number, admission and separation dates) and clinical information,[23] and are compiled into the Hospital Morbidity Database by the Canadian Institute for Health Information.[24] During processing at Statistics Canada, about 3% of Hospital Morbidity Database records for patients aged 12 or older were excluded because of missing or invalid health numbers.[22] Because this analysis was restricted to records for hospitalizations in acute care hospitals, a further 2% of records from non-acute care institutions were excluded.

After processing to ensure the consistency of demographic information among records assumed to pertain to the same person, two stages of linkage were carried out. First, HPOI records were created by linking records for the same patient, based on health number, postal code and date of birth. Probabilistic linkage routines were then used to match the CCHS with HPOI records.

A recently published evaluation of the linkage between the CCHS and HPOI reported high coverage for the population younger than age 75. The estimated number of people aged 12

to 74 who were hospitalized, based on the number of CCHS records that were matched to HPOI records, was 96.4% of the number hospitalized according to HPOI records alone.[25] To further assess the comparability of the linked file with the original CCHS file (excluding Quebec respondents, but including respondents who did not give permission for linkage), the population distribution by smoking status (percentage who are current smokers, never-smokers, former smokers who quit within five years, former smokers who quit for more than five years) was compared between the two files; the distributions were nearly identical (data not shown).

CCHS interviews were conducted from September 1, 2000 until November 3, 2001. Starting from the date of the CCHS interview, HPOI records were searched prospectively for four years (1,462 days) for each respondent. Thus, in theory, each respondent had an equal period of eligibility for hospitalization. Censoring before the end of the four-year period because of events such as death or moving out of the province could not be accounted for because information about these events was not available or incomplete. However, it was expected that such occurrences would be relatively rare in the age group studied and would have a minimal effect on the results of the analysis. Probabilistic linkage of the 28,288 CCHS records to HPOI records yielded 7,229 matches, indicating that 26% of CCHS respondents outside Quebec had been hospitalized at least once during the four-year follow-up. No matching HPOI records within the four-year follow-up were found for the remaining 21,059 respondents, who were, therefore, categorized as not having been hospitalized. No information on smoking status was available for 13 of those who had been hospitalized and for 20 of those who had not. These records were deleted, yielding final samples of 7,216 and 21,039, respectively.

Analytical techniques

Frequencies, cross-tabulations and means were employed to estimate smoking prevalence, the proportions of persons hospitalized, and hospital days used. All tabulations were produced by age group, and all computations were carried out with weighted data. Variance on estimates was calculated with the bootstrap technique to account for the complex design of the survey.[26,27]

Preliminary analysis revealed that relatively few (7%) CCHS respondents aged 75 or older were current daily smokers. As well, for the population aged 75 or older, correspondence between the CCHS and HPOI is substantially lower than for younger people—largely because the CCHS does not cover the institutionalized population.[25] Therefore, the analysis excluded people aged 75 or older.

Four multiple logistic regression models were fitted to assess the association between smoking status (as ascertained during the CCHS interview) and the odds of hospitalization, while controlling for potential confounders. The first model contained control variables for age and sex; to that model were added variables reflecting socio-economic status (Model 2), urban/rural residence (Model 3), and physician consultations, leisure-time physical activity, body mass index and level of alcohol consumption (Model 4). To maximize sample size, variables for missing values on household income, leisure-time physical activity and body mass index were included. Cox proportional hazards regression, useful in assessing time-to-first-event, was also considered as a means of studying this association. However, because time-to-hospitalization was unrelated to the purpose of the regression (to assess the possible influence of socio-economic status and other risk factors on the association between smoking and hospitalization), logistic regression was considered an appropriate approach.

Definitions

Respondents were assigned to one of four categories, based on daily smoking: current daily smoker; former daily smoker who quit sometime in the five years before the date of the CCHS interview (recent quitters); former daily smoker who quit more than five years before the date of the interview (long-term quitters); and never a daily smoker.

To be consistent with low-risk drinking guidelines,[28] seven categories of alcohol consumption were specified: weekly binge (at least five drinks in one occasion, at least once a week during past year); heavy (ten drinks or more in past week for women; fifteen or more for men); moderate (two to nine drinks in past week for women; two to fourteen for men); light (one drink in past week); occasional (at least one drink in past year, but none in past week); former (at least one drink in lifetime, but none in past year); and lifetime abstainer.

Household income groups were derived by calculating the ratio between total household income from all sources in the previous 12 months and Statistics Canada's low-income cut-off specific to the number of people in the household, the size of the community, and the survey year. These adjusted income ratios were sorted and grouped into within-province quintiles (five groups, each containing one-fifth of the population in each province).

Days in hospital were calculated by summing the lengths of stay for each hospitalized CCHS respondent; totals were cross-tabulated by age group and smoking status category. Respondents categorized as not having been hospitalized were included and counted as contributing zero days.

The average number of days in hospital was calculated by dividing the weighted total number of days for each age group and smoking category by the corresponding weighted population count. For each age group and smoking category, the average number of excess hospital days was calculated by subtracting the average number of days for never-smokers from the corresponding average number of days for each smoking category. Then the total number of excess days in hospital was calculated by multiplying the average number of excess days in each age group and smoking category by the population

in each of these groups. Finally, the percentage of all days in hospital that were excess days was calculated by dividing the number of excess days by the number of total days. All estimates were produced for each age group and smoking category.

Results

Of Canadians (minus Quebec residents) aged 45 to 74 in 2000/2001, an estimated 19% were current daily smokers; 6% were former daily smokers who had quit in the past five years (recent quitter); 30% were former daily smokers who had quit for more than five years (long-term quitter); and 44% had never smoked daily (Table 1). The percentage of current daily smokers in the 45-to-54 age group was higher than in the older age groups.

Over the subsequent four-year period, 14% of people aged 45 to 54 were hospitalized—a figure that rose in successively older age groups to 35% of 65- to 74-year-olds (Table 2). When smoking status was considered, the likelihood of hospitalization during the four years ranged from a low of 12% of never-smokers aged 45 to 54 to a high of 43% of 65- to 74-year-olds who were current daily smokers or recent quitters.

In each age group, the percentage of current daily smokers who were hospitalized substantially exceeded the percentage among those who had never smoked daily. In all age groups, recent quitters were also significantly more likely to have been hospitalized than were people who had never smoked daily. This pattern held for long-term quitters except at ages 55 to 64: the percentage of long-term quitters hospitalized was not statistically different from the percentage for people who had never smoked daily.

Adjusted for age and sex, the odds of hospitalization for current daily smokers were 80% higher than those for never daily smokers (Table 3, Model 1). The odds ratios for former daily smokers were also significantly elevated, at 1.6 for recent quitters, and 1.3 for long-term quitters. Even as other control variables were added (level of education and income in Model 2; urban/rural residence in Model 3; and family doctor consultation, level of leisure-time physical activity, body mass index category and level of alcohol consumption in Model 4), the odds ratios for all smoking categories remained at nearly the same levels.

More hospital days

The time current and former daily smokers spent in hospital was disproportionate to their share of the population. Current daily smokers aged 45 to 74 accounted for 19% of the population in that age

Table 1
Smoking status, by age group, household population aged 45 to 74, Canada excluding Quebec, 2000/2001

	Current daily smoker				Recent quitter (5 or fewer years)				Long-term quitter (more than 5 years)				Never smoked daily			
	Estimated number		95% confidence interval		Estimated number		95% confidence interval		Estimated number		95% confidence interval		Estimated number		95% confidence interval	
Age group	'000	%	from	to	'000	%	from	to	'000	%	from	to	'000	%	from	to
Total 45 to 74	**1,361.8**	**19.4**	**18.7**	**20.1**	**444.1**	**6.3**	**5.9**	**6.7**	**2,098.9**	**29.9**	**29.1**	**30.8**	**3107.9**	**44.3**	**43.4**	**45.3**
45 to 54	783.1	23.2	22.1	24.3	227.4	6.7	6.1	7.4	839.9	24.9	23.6	26.1	1525.0	45.2	43.7	46.7
55 to 64	388.0	19.0*	17.7	20.3	129.3	6.3	5.6	7.0	663.2	32.5*	31.0	33.9	861.8	42.2*	40.5	43.9
65 to 74	190.7	12.0*	10.9	13.0	87.4	5.5*	4.7	6.3	595.8	37.4*	35.7	39.0	721.1	45.2	43.4	47.0

* significantly different from estimate for ages 45-54 ($p < 0.05$)
Note: Estimates are based on a sample of 28,255 respondents to 2000/2001 Canadian Community Health Survey.
Source: 2000/2001 Canadian Community Health Survey.

Table 2
Percentage hospitalized over subsequent four years, by age group and smoking status, household population aged 45 to 74 in 2000/2001, Canada excluding Quebec

	Total			Current daily smoker			Recent quitter (5 or fewer years)			Long-term quitter (more than 5 years)			Never smoked daily		
		95% confidence interval			95% confidence interval			95% confidence interval			95% confidence interval			95% confidence interval	
Age group	%	from	to	%	from	to	%	from	to	%	from	to	%	from	to
45 to 54	14.4	13.4	15.4	18.6*	16.6	20.6	17.6*	13.5	21.7	14.8*	12.5	17.1	11.6	10.4	12.9
55 to 64	23.1	21.7	24.5	28.7*	25.2	32.1	27.1*	22.0	32.1	22.9	20.5	25.3	20.1	17.9	22.4
65 to 74	35.1	33.3	36.9	43.1*	38.6	47.6	42.6*	35.8	49.4	38.2*	35.6	40.9	29.5	26.8	32.2

* significantly different from estimate for "never smoked daily" ($p < 0.05$)
Source: 2000/2001 Canadian Community Health Survey linked to 2000-2005 Hospital Person-Oriented Information.

Table 3
Adjusted odds ratios relating smoking status to hospitalization over subsequent four years, controlling for selected characteristics, household population aged 45 to 74 in 2000/2001, Canada excluding Quebec

	Model 1			Model 2			Model 3			Model 4		
	Adjusted odds ratio	95% confidence interval		Adjusted odds ratio	95% confidence interval		Adjusted odds ratio	95% confidence interval		Adjusted odds ratio	95% confidence interval	
		from	to		from	to		from	to		from	to
Smoking status												
Current daily	1.8*	1.6	2.0	1.6*	1.5	1.9	1.6*	1.4	1.8	1.7*	1.5	1.9
Recent quitter (5 or fewer years)	1.6*	1.4	2.0	1.6*	1.3	1.9	1.6*	1.3	1.9	1.5*	1.3	1.8
Long-term quitter (more than 5 years)	1.3*	1.2	1.5	1.3*	1.2	1.5	1.3*	1.2	1.4	1.3*	1.2	1.5
Never smoked daily†	1.0	...	...	1.0	...	...	1.0	...	...	1.0	...	...
Age (continuous)	1.1*	1.1	1.1	1.1*	1.1	1.1	1.1*	1.1	1.1	1.1*	1.1	1.1
Sex												
Men	1.0	0.9	1.1	1.1	1.0	1.2	1.1	1.0	1.2	1.2*	1.0	1.3
Women†	1.0	...	...	1.0	...	...	1.0	...	...	1.0	...	...
Education												
Less than secondary graduation	...	...	...	1.2*	1.0	1.3	1.1	1.0	1.2	1.0	0.9	1.1
Secondary graduation	...	...	...	1.0	0.9	1.2	1.0	0.9	1.2	1.0	0.9	1.2
Some postsecondary	...	...	...	1.2	1.0	1.4	1.2	1.0	1.4	1.2	1.0	1.4
Postsecondary graduation†	...	...	...	1.0	...	...	1.0	...	...	1.0	...	...
Household income quintile												
1 (lowest)	...	...	...	1.5*	1.3	1.8	1.6*	1.4	1.9	1.4*	1.2	1.7
2	...	...	...	1.3*	1.1	1.5	1.3*	1.1	1.5	1.2	1.0	1.4
3	...	...	...	1.0	0.9	1.2	1.1	0.9	1.2	1.0	0.9	1.2
4	...	...	...	1.1	1.0	1.3	1.2*	1.0	1.3	1.1	1.0	1.3
5 (highest)†	...	...	...	1.0	...	...	1.0	...	...	1.0	...	...
Urban/Rural residence												
Census Metropolitan Area (CMA)†	...	...	...	...	...	...	1.0	...	...	1.0	...	...
Non-CMA urban	...	...	...	...	...	...	1.4*	1.3	1.6	1.4*	1.3	1.6
Non-CMA rural	...	...	...	...	...	...	1.3*	1.2	1.5	1.3*	1.2	1.5
Consulted family doctor/general practitioner in past 12 months												
Yes	...	...	...	...	...	...	...	...	...	1.8*	1.5	2.1
No†	...	...	...	...	...	...	...	...	...	1.0	...	...
Leisure-time physical activity level												
Active (3 or more KKD)†	...	...	...	...	...	...	...	...	...	1.0	...	...
Moderately active (1.5 to 2.9 KKD)	...	...	...	...	...	...	...	...	...	1.0	0.9	1.2
Inactive (Less then 1.5 KKD)	...	...	...	...	...	...	...	...	...	1.3*	1.2	1.5
BMI category (range kg/m²)												
Underweight (less than 18.5)	...	...	...	...	...	...	...	...	...	1.4*	1.0	1.9
Normal weight (18.5 to 24.9)†	...	...	...	...	...	...	...	...	...	1.0	...	...
Overweight (25.0 to 29.9)	...	...	...	...	...	...	...	...	...	1.1	1.0	1.2
Obese Class I (30.0 to 34.9)	...	...	...	...	...	...	...	...	...	1.2*	1.1	1.4
Obese Class II (35.0 to 39.9)	...	...	...	...	...	...	...	...	...	1.7*	1.3	2.3
Obese Class III (40.0 or more)	...	...	...	...	...	...	...	...	...	1.8*	1.3	2.6
Level of alcohol consumption												
Weekly binge drinker	...	...	...	...	...	...	...	...	...	1.0	0.8	1.3
Heavy last week	...	...	...	...	...	...	...	...	...	0.8	0.7	1.1
Moderate last week†	...	...	...	...	...	...	...	...	...	1.0	...	...
Light last week	...	...	...	...	...	...	...	...	...	1.2*	1.0	1.5
Occasional drinker	...	...	...	...	...	...	...	...	...	1.3*	1.1	1.4
Former drinker	...	...	...	...	...	...	...	...	...	1.5*	1.3	1.7
Lifetime abstainer	...	...	...	...	...	...	...	...	...	1.3	1.0	1.6

† reference category
* significantly different from reference category ($p < 0.05$)
... not applicable
KKD: kilocalories per kilogram per day
Source: 2000/2001 Canadian Community Health Survey linked to 2000-2005 Hospital Person-Oriented Information.

range in 2000/2001, but they used 29% of hospital days for that age group (Table 4). Recent quitters constituted 6% of the population, but accounted for 10% of hospital days. Long-term quitters used a percentage of hospital days (32%) that more closely reflected their share of the population (30%). Finally, people who had never smoked daily made up 44% of the population, but used 30% of hospital days.

The mean number of days in hospital per person (including those who were not hospitalized during the study period) was significantly higher for current daily smokers than for people who had never smoked daily. In each age group, the average for current daily smokers was more than double that for never-daily smokers (Table 5). Recent quitters also averaged significantly more days in hospital, compared with never-daily smokers.

For long-term quitters aged 45 to 64, average days in hospital did not statistically exceed averages for never-daily smokers. However, average days in hospital for long-term quitters aged 65 to 74 (6.8 days) significantly surpassed the average for never-daily smokers in this age group (4.3 days).

Current daily smokers' average number of *excess* hospital days ranged from 1.5 days at ages 45 to 54 to 6.0 days at ages 65 to 74. Recent quitters' excess days averaged 0.9 at ages 45 to 54, 2.6 at ages 55 to 64, and 8.4 days at ages 65 to 74. For long-term quitters, average excess days at ages 45 to 64 did not differ significantly from zero; those aged 65 to 74 averaged 2.6 excess days, which was significantly lower than the average of 8.4 excess days for recent quitters.

In total, current and former daily smokers aged 45 to 74 used an excess of 7.1 million hospital days over the four-year study period, which accounted for nearly one-third (32%) of all days spent in hospital by people these ages (Table 6). This proportion was consistent in all three age groups. When the analysis

Table 4
Number of days and percentage distribution of days in hospital over subsequent four years, by age group and smoking status, household population aged 45 to 74 in 2000/2001, Canada excluding Quebec

		Current daily smoker			Recent quitter (5 or fewer years)			Long-term quitter (more than 5 years)			Never smoked daily		
	Total estimated number of hospitals days '000	Estimated number of hospital days '000	Percent of		Estimated number of hospital days '000	Percent of		Estimated number of hospital days '000	Percent of		Estimated number of hospital days '000	Percent of	
Age group			hospital days	age group†		hospital days	age group†		hospital days	age group†		hospital days	age group†
Total 45 to 74	**21,853.5**	**6,250.7**	**28.6**	**19.4**	**2,164.9**	**9.9**	**6.3**	**6,892.6**	**31.5**	**29.9**	**6,545.3**	**30.0**	**44.3**
45 to 54	5,060.1	1,999.2	39.5	23.2	430.1	8.5	6.7	1,062.4	21.0	24.9	1,568.4	31.0	45.2
55 to 64	6,558.8	2,298.6	35.0	19.0	622.5	9.5	6.3	1,753.3	26.7	32.5	1,884.4	28.7	42.2
65 to 74	10,234.6	1,952.9	19.1	12.0	1,112.3	10.9	5.5	4,076.9	39.8	37.4	3,092.6	30.2	45.2

† shown to facilitate comparisons between percentage of people comprised by age group and percentage of hospital days used
Source: 2000/2001 Canadian Community Health Survey linked to 2000-2005 Hospital Person-Oriented Information.

Table 5
Average number of days and excess days hospitalized over subsequent four years, by age group and smoking status, household population aged 45 to 74 in 2000/2001, Canada excluding Quebec

	Current daily smoker			Recent quitter (5 or fewer years)			Long-term quitter (more than 5 years)			Never smoked daily		
		95% confidence interval			95% confidence interval			95% confidence interval			95% confidence interval	
Age group	%	from	to	%	from	to	%	from	to	%	from	to
	Average number of days in hospital over four years											
45 to 54	2.6*	2.0	3.1	1.9*	1.1	2.6	1.3	0.9	1.6	1.0	0.8	1.3
55 to 64	5.9*	3.9	7.9	4.8*	3.2	6.4	2.6	2.2	3.1	2.2	1.7	2.6
65 to 74	10.2*	8.0	12.5	12.7*	8.4	17.1	6.8*	6.0	7.7	4.3	3.6	5.0
	Average number of excess† days in hospital over four years among current and former daily smokers											
45 to 54	1.5	0.9	2.2	0.9	0.1	1.7	0.2	-0.2	0.7	...	...	...
55 to 64	3.7	1.7	5.8	2.6	1.0	4.3	0.5	-0.2	1.1	...	...	...
65 to 74	6.0	3.6	8.3	8.4	4.0	12.9	2.6	1.4	3.7	...	...	...

* significantly different from estimate for "never smoked daily" ($p < 0.05$)
† calculated by subtracting estimate for "never smoked daily" from total average number of days for corresponding age group; detail may not add to total because of rounding
... not applicable
Note: Average number of days in hospital is based on total population (including those not hospitalized).
Source: 2000/2001 Canadian Community Health Survey linked to 2000-2005 Hospital Person-Oriented Information.

Table 6
Number of excess days† hospitalized over subsequent four years, by age group and smoking status, household population aged 45 to 74 in 2000/2001, Canada excluding Quebec

	Current daily smoker	Recent quitter (5 or fewer years)	Long-term quitter (more than 5 years)	Total current daily and former daily smoker	
	Estimated number '000	Estimated number '000	Estimated number '000	Estimated number '000	%‡
Total 45 to 74	**3,779.0**	**1,273.6**	**2,023.6**	**7,076.2**	**32.4**
45 to 54	1,193.8	196.2	198.6	1,588.6	31.4
55 to 64	1,450.2	339.7	303.1	2,093.0	31.9
65 to 74	1,135.1	737.6	1,521.9	3,394.6	33.2

† average number of excess days (Table 5) multiplied by number of people in corresponding age group and smoking category (Table 1)
‡ calculated by dividing number of excess days by total number of days (Table 4)
Source: 2000/2001 Canadian Community Health Survey linked to 2000-2005 Hospital Person-Oriented Information

was repeated for the sexes separately, the excess was 36% of all days for men, and 28% of all days for women (data not shown).

Discussion

For the first time, population-based estimates of acute care hospital use in Canada (excluding Quebec) in relation to the smoking status of patients have been prospectively estimated—using linked survey and administrative data. The results indicate that excess days spent in hospital by current and former daily smokers aged 45 to 74 account for nearly one-third of all days spent in hosptial by people in this age range. Furthermore, the elevated likelihood of hospitalization for current and former smokers is not explained by other characteristics, including socio-economic status.

The relatively lower averages of excess hospital days for former daily smokers who had quit more than five years before their CCHS interview underscores the benefit of long-term cessation. This finding is consistent with research reported by the United States Surgeon General showing improvements in mortality risk with time since quitting.[29]

A previous study reported increases in hospital admissions for former smokers during the year in which they quit, leading the investigators to speculate that the onset of illness may have motivated their quitting.[30] This may explain the high average number of excess hospital days for quitters of five years or less in the 65 to 74 age group in the current study.

Previous Canadian studies of various smoking-related outcomes (for example, health care use, direct and indirect costs, and mortality) have been based on the attributable-fraction methodology, making comparisons with the current study problematic.[2,3,6] The aim of the current study was to quantify hospital use according to the patient's smoking status, without regard to the age-specific, smoking-attributable fraction of the patient's diagnosis.

Comparisons with studies from other countries based on methodology similar to the current study are also limited—by differences in study endpoints, smoking prevalence, and follow-up time. For example, in a 16-year follow-up of a nationally representative cohort in Finland, male smokers used 70% more hospital days, and female smokers, 49% more, than did never smokers.[17] In a 30-month prospective study in Japan, the per capita cost of hospital inpatient care was 33% higher for male smokers, compared with non-smokers, but did not differ among females.[16] In Scotland, the odds of hospitalization for a cohort followed for 7.5 years were significantly higher for smokers and former smokers.[19] Despite the variety of methodological approaches among studies, the consistent finding is that smoking is a factor in an appreciable proportion of hospital care.

What is already known on this subject?

- Smoking causes a variety of diseases and premature death.
- Previous Canadian estimates of smoking-related hospital days—derived from applying disease-specific risk estimates to administrative data—have indicated that smoking accounts for a substantial share of acute care.

What does this study add?

- With population-based survey data linked to hospitalization data, acute care hospital use by smoking status has been prospectively estimated for the cohort of respondents (except those in Quebec) to the 2000/2001 Canadian Community Health Survey.
- Smokers and former smokers had higher odds of hospitalization, even when controling for influences other than smoking.
- Former smokers aged 45 to 64 who had quit for more than five years averaged no more days in hospital than did never-daily smokers.
- Compared with never-daily smokers, excess days used by current daily and former daily smokers aged 45 to 74 amounted to nearly one-third of all acute care hospital days used by the population in this age range.

Limitations

An important limitation of this study is the exclusion of residents of Quebec, where the prevalence of smoking was higher in 2000/2001.[31] Exclusion of the institutionalized and on-reserve populations further added to the undercounting of hospital days used. Although CCHS respondents for whom a valid health number was not available and those who did not give permission to

link their survey data with administrative data were also omitted. Statistics Canada produced special survey weights to adjust for these exclusions.

The hospital care received by smokers is underestimated in this analysis. Data on use of the emergency and outpatient departments were not available. As well, because data were available only from acute care hospitals, specialized facilities such as psychiatric and rehabilitation centres were excluded. And the extent to which exposure to second-hand smoke may have been related to days in hospital could not be estimated.

The maximum response category for the 2000/2001 CCHS question asked of former daily smokers about time since quitting was "more than 5 years ago." A more detailed breakdown (for example, 5 to 10 years; 10 years or more) would have permitted an examination of the length of cessation time that is required before hospital use by former smokers might fully drop to the level of people who have never smoked. As well, information on intensity of exposure to smoking (pack-years) was not available.

Smoking status was assessed only at the beginning of the period and may have changed during the subsequent four years. Current smokers could have quit, and former smokers could have resumed. Previous research based on longitudinal data indicates that within a two-year period, 13% of daily smokers had quit.[32] However, among former smokers, recidivism was particularly high in the first two years—approximately 20% had relapsed. Although the full extent to which such changes may have diluted or biased the observed associations cannot be quantified, it is likely that the association with hospitalization observed for people classified as recent quitters (quit in past five years) was stronger than it would have been if recidivists had been excluded.

Factors other than smoking that could not be included in the analysis may account for some of the excess hospitalization among smokers. Such factors might include a propensity for risk-taking, poorer nutritional status and less frequent primary and preventive care.

Data from the CCHS were self-reported by respondents; no independent verification of the information was undertaken. The degree to which the data may be biased because of reporting error is unknown. For example, any tendency to deny or underreport smoking would contribute to misclassification, which would weaken the strength of the association between hospital use and smoking.

Probabilistic linkage was used to match hospitalization records to survey records; some false links or missed links may have resulted.

Conclusion

This analysis illustrates the value of linking administrative to survey data by being the first Canadian study to directly quantify time spent in hospital according to smoking status. The precision of the association between hospitalization and smoking status was enhanced by controlling for other possible influences such as obesity and socio-economic status. ■

References

1. Rice DP, Hodgson TA, Sinsheimer P, et al. The economic costs of the health effects of smoking, 1984. *The Milbank Quarterly* 1986; 64(4): 489-547.
2. Kaiserman MJ. The cost of smoking in Canada, 1991. *Chronic Diseases in Canada* 1991; 18: 13-9.
3. Single E, Rehm J, Robson L, et al. The relative risks and etiologic fractions of different causes of death and disease attributable to alcohol, tobacco and illicit drug use in Canada. *Canadian Medical Association Journal* 2000; 162(12): 1669-75.
4. Forbes SF, Thompson ME. Estimating the health care costs of smokers. *Canadian Journal of Public Health* 1983; 74: 183-90.
5. Warner KE, Hodgson TA, Carroll CE. Medical costs of smoking in the United States: estimates, their validity, and their implications. *Tobacco Control* 1999; 8: 290-300.
6. Baliunas D, Patra J, Rehm J, et al. Smoking-attributable morbidity: acute care hospital diagnoses and days of treatment in Canada, 2002. *BMC Public Health* 2007; 7: 247. Available at: http://www.biomedcentral.com/1471-24578/7/247.
7. Sadr Azodi O, Bellocco R, Eriksson K, et al. The impact of tobacco use and body mass index on the length of stay in hospital and the risk of post-operative complications among patients undergoing total hip replacement. *Journal of Bone and Joint Surgery* 2006; 88-B: 1316-20.
8. Theadom A, Cropley M. Effects of preoperative smoking cessation on the incidence and risk of intraoperative and postoperative complications in adult smokers: a systematic review. Downloaded from tobaccocontrol.bmj.com, 12 April 2007: 352-8.
9. Delgado-Rodriguez M, Median-Cuadros M, Martinez-Gallego G, et al. A prospective study of tobacco smoking as a predictor of complications in general surgery. *Infection Control and Hospital Epidemiology* 2003; 24: 37-43.
10. Moller AM, Pedersen T, Villebro N, Munksgaard A. Effect of smoking on early complications after elective orthopaedic surgery. *Journal of Bone and Joint Surgery* 2003a; 85B: 178-81.
11. Moller AM, Pedersen T, Villebro N, et al. A study of the impact of long-term tobacco smoking on postoperative intensive care admission. *Anaesthesia* 2003; 58: 55-9.
12. Myles PS, Iacono GA, Hunt JO, et al. Risk of respiratory complications and wound infection in patients undergoing ambulatory surgery. *Anesthesiology* 2002; 97(4): 842-7.
13. Lavernia CJ, Sierra RJ, Gomez-Marin O. Smoking and joint replacement: Resource consumption and short term outcome. *Clinical Orthopaedics and Related Research* 1999; 367: 172-80.
14. Dilworth JP, White RJ. Postoperative chest infection after upper abdominal surgery: an important problem for smokers. *Respiratory Medicine* 1992; 86: 205-10.
15. Handlin DS, Baker T. The effects of smoking on postoperative recovery. *The American Journal of Medicine* 1992; 93(suppl 1A): 32S-37S.
16. Izumi Y, Tsuji I, Ohkubo T, et al. Impact of smoking habit on medical care use an its costs: a prospective observation of National Health Insurance beneficiaries in Japan. *International Journal of Epidemiology* 2001; 30: 616-21.
17. Haapanen-Niemi N, Miilunpalo S, Vuori I, et al. The impact of smoking, alcohol consumption, and physical activity on use of hospital services. *American Journal of Public Health* 1999; 89(5): 691-8.
18. Newcombe HB. *Handbook of Record Linkage*. Oxford: Oxford University Press, 1988.
19. Hanlon P, Lawder R, Elders A, et al. An analysis of the link between behavioural, biological and social risk factors and subsequent hospital admission in Scotland. *Journal of Public Health* 2007; 29(4): 405-12.
20. Plotnikoff RC, Karunamuni ND, Johnson JA, et al. Health-related behaviours in adults with diabetes—Associations with health care utilization and costs. *Canadian Journal of Public Health* 2008; 99(3): 227-31.
21. Béland Y., Dale V., Dufour J., Hamel M. (2005). The Canadian Community Health Survey: Building on the Success from the Past. *Proceedings of the American Statistical Association Joint Statistical Meetings 2005, Section on Survey Research Methods*. Minneapolis, August 2005.
22. Statistics Canada, Household Surveys Methodology Division. *External Linkage of Person-oriented Information 1992/93 to 2000/01 Hospital Morbidity Files*. (unpublished) Ottawa: Statistics Canada, 2003.
23. Richards J, Brown A, Homan C. The data quality study of the Canadian Discharge Abstract Database. *Proceedings of Statistics Canada Symposium 2001 Achieving Data Quality in a Statistical Agency: A Methodological Perspective*, 2001: 1-12.
24. Canadian Institute for Health Information. *Data Quality Documentation: Hospital Morbidity Database (HMDB) 2001-2002*. Ottawa: Canadian Institute for Health Information, 2005.
25. Rotermann M. Evaluation of the coverage of linked Canadian Community Health Survey and hospital inpatient records. *Health Reports* (Statistics Canada, Catalogue 82-003) 2009; 20(1): 45-51. Available at: http://www.statcan.gc.ca/cgi-bin/af-fdr.cgi?l=eng&loc=2009001/article/10773-eng.pdf. Accessed February 2, 2009.
26. Rao JNK, Wu CFJ, Yue K. Some recent work on resampling methods for complex surveys. *Survey Methodology* (Statistics Canada, Catalogue 12-001) 1992; 18(2): 209-17.
27. Rust KF, Rao JNK. Variance estimation for complex surveys using replication techniques. *Statistical Methods in Medical Research* 1996; 5: 281-310.
28. Bondy SJ, Rehm J, Ashley MJ, et al. Low-risk drinking guidelines: The scientific evidence. *Canadian Journal of Public Health* 1999; 90(4): 264-70.
29. US Department of Health and Human Services. *The Health Benefits of Smoking Cessation*. DHHC Publication No. (CDC) 90-8416. Atlanta, Georgia: US Department of Health and Human Services, 1990.
30. Wagner EH, Curry SJ, Grothaus L, et al. The impact of smoking and quitting on health care use. *Archives of Internal Medicine* 1995; 155: 1789-95.
31. Shields M. Smoking—prevalence, bans and exposure to second-hand smoke. *Health Reports* (Statistics Canada, Catalogue 82-003) 2007; 18(3): 67-85.
32. Shields M. The journey to quitting smoking. *Health Reports* (Statistics Canada, Catalogue 82-003) 2005; 16(3): 19-36.